LABOR STANDARDS APPLICATION PROGRAM

BLAST AND PAINT SHOPS

FINAL REPORT

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NATIONAL SHIPBUILDING RESEARCH PROGRAM

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS

SHIP PRODUCTION COMMITTEE

PANEL SP-8

PETERSON BUILDERS, INC.

LABOR STANDARDS APPLICATION PROGRAM

PHASE IV - FY-83

BLAST AND PAINT SHOPS

FINAL REPORT

TASK ES-8-19

Submitted to:

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This project is managed and cost-shared by Peterson Builders, Inc. for the National Shipbuiding Research Program. The program is a cooperative effort of the Maritime Administration's Office of Advanced Ship Development, the U.S. Navy, the U.S. shipbuilding industry, and selected academic institutions.

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FINAL REPORT

1. Program Objective

This Report describes the participation of Peterson Builders, Inc. in the Maritime Administration (MarAd) National Shipbuilding Research Program for FY-83 to implement labor standards during ship construction towards controlling production costs in the two closely related areas of blasting and painting. The overall objective of this Research Program is to reduce the cost of building ships. The objective of this specific project in the blast/paint areas was to improve planning, scheduling, production control, and worker productivity through the application of labor standards, and thereby reduce the cost of blasting/painting operations.

2. Project Conceptual Plan

The PBI proposal for this project lists six major Tasks intended for accomplishment during this .program. These Tasks outline the

general commitments considered necessary to provide a workable and successful program for implementing labor standards. The listing that follows briefly describes these Tasks, which cover a broad range of effort.

Task A - Develop procedures, charts, and other forms for presenting labor standards information at a level of detail suitable for use by planners and schedulers in applying labor standards to actual production work.

Task B - Determine non-process factors in each area of concern.

Task C - in planners and schedulers in techniques for applying labor standards;

Task D - Instruct supervisors' on the purpose and application of labor standards.

Task E - Develop a system to monitor the currentness of labor standards.

Task F - Write a final report summarizing program success./failure, productivity and cost savings attainable, and related conclusions.

The format used for developing-labor standards data prior to the

FY-83 program was the H. B. Maynard Work Management Manual (WMM) which served as a guide to the process of obtaining and documenting standard data. Each of the ten sections of the WMM identified specific data covering the conditions that occurred on the job. In conjunction with the WMM, the Maynard Operational Sequence Technique (MOST) was the system used to process the standard data. The several work methods involved in each area of concern were identified, and labor time was assessed to each of them.

The FY-83 MarAd program commitment was to implement labor standards in the areas for which labor standard" data had already been developed during the FY-82 program. Before the actual start of the FY-83 program, the need for a more detailed plan that would direct efforts to implement labor standards and accomplish the goals of the FY-83 program was clearly recognized. This plan 'was devised by P231, and was termed the MarAd Project General Approach. The plan would: (1) list the phases that had to be accomplished; (2) state the objectives to be met during each phase; (3) provide a procedural step-by-step plan of action and sequence for carrying out each phase; and (4) make it possible to establish schedules leading to completion of the phases and the project on time.

The development of each phase would consist of: (a) a written' statement of the objective of that phase; (b) a detailed plan of action; (c) the actual implementation of the plan of action to

accomplish the given objective; and (d) a follow-up report of results, problems, and actions taken or needed to improve conditions and achieve the goals of the overall project.

3. Methodology

The specific approach used during this project is described below, and consists of seven Phases, the last two of which were not reached (See paragraph 4.1). These Phases are first listed, and are then described individually in detail. (Note: PBI, General Operating Procedures in the blast and paint shops are contained in Appendix A.)

Phase I - Establish Baseline Data
Phase II - Validate Labor Standards
Phase III - Formalize Queuing Procedures
Phase IV - Apply Labor Standards
Phase V - Examine Delay Time (Project terminated here.)
Phase VI - Refine Application Procedures
Phase VII - Evaluate Cost Effectiveness

3.1 Phase I - Establish Baseline Data

The purpose of obtaining baseline data was to capture working conditions on the job prior to the application of labor standards. The absence of adequate labor reporting records and performance data with which to compare productivity changes made

the collection of baseline data absolutely essential. The system of labor reporting did not identify the individual job. Rather, labor time was charged to a general account number encompassing many jobs.

Baseline data was gathered using forms designed by PBI called Activity Sheets (Appendices B and C). On these sheets were recorded the actual methods being employed and actual worker time on the job. Information on non-process conditions was also gathered on these same sheets.

A Product Mix Sheet (Appendix D) was also used to see what impact a variable product mix might have on establishing a format to apply labor standards. Part configuration was found to be more important than product mix.

A spot sampling check was also used as a technique to get on-the-spot data, without involving any judgement factors. This technique was used to sample value-added time, as follows:

- Process time with value-added - time that adds value to the product, enhances it; machining, welding, painting, etc.

- Process time with no value-added - time that does not add value to the product, but is necessary to get the job done; load and unload piece.

Non-process time with no value-added - in effect, wasted time; idle time, improper method.

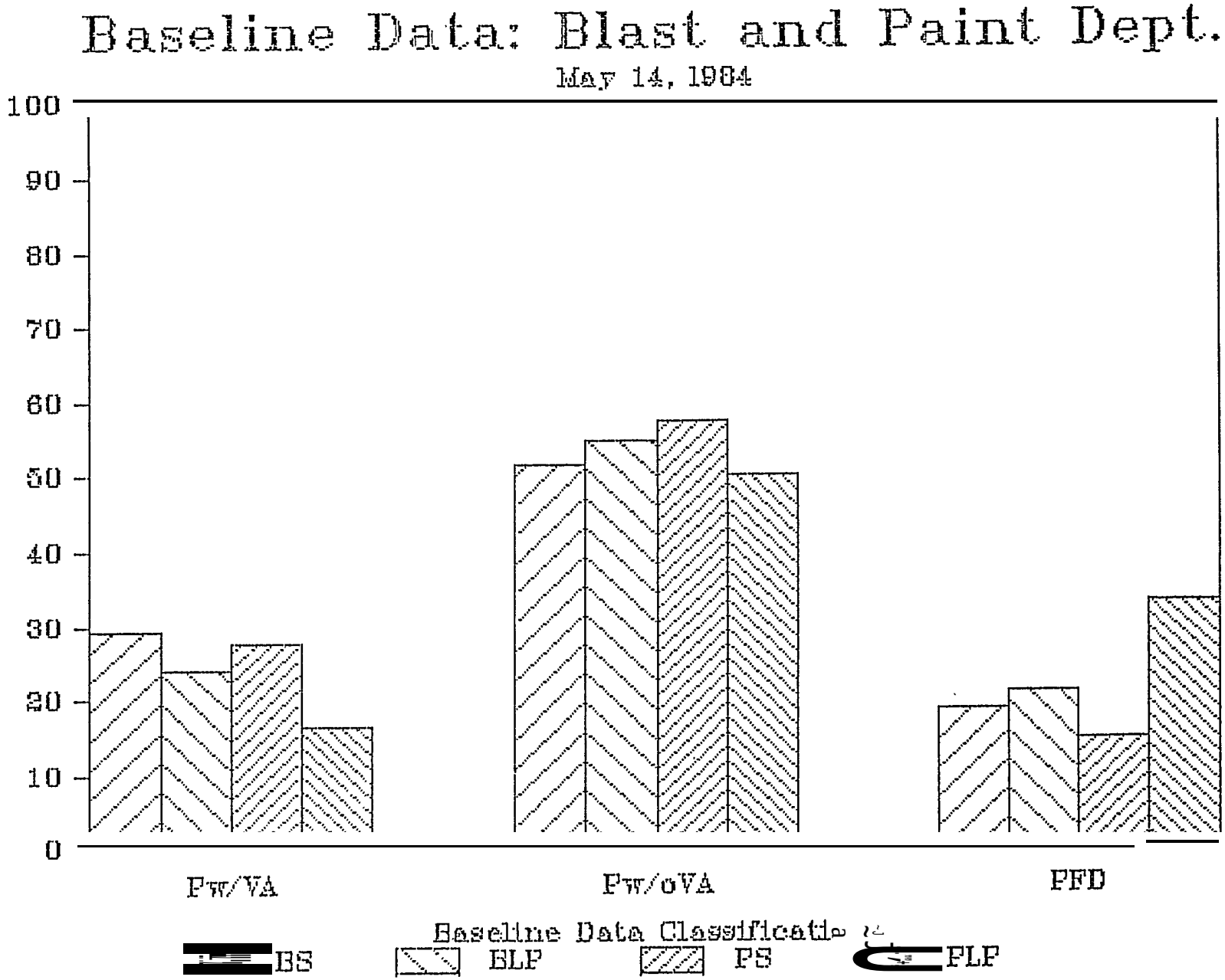
Figure l.shows value-added comparisons based on worker activities in the blast/paint areas.

Abbreviations for Figure 1

Pw/VA	-	Process with value added
Pw/oVA	-	Process without value added
PFD	-	Personal, fatigue, and delay
BS	-	Blasting sections,
BLP	-	Blasting loose parts
PS	-	Painting sections
PLP	-	Painting loose parts

Figure 1

Worker activity(%)



3.2 Phase II - Validate Labor Standards

Validation of existing labor standards was considered necessary to determine whether methods observed earlier in the FY-82 labor standards program had changed, and would require updating. Current methods were observed to substantiate whether they were still being used, as well as to measure the related labor times. Changes were reviewed and questioned, as were any new methods encountered in the blast/paint areas. Where a change did occur, evaluation was carried out to determine whether it: (1) involved improved paint application; (2) improved blasting capacity and skill; (3) reduced the time to do the work; (4) added truly necessary steps; and (5) changed shop conditions or facilities.

The validation process was an effective way to identify and remove from consideration those methods that were no longer used, and to correct those methods that had changed substantially. One of the major changes encountered was that the paint shop had shifted to almost 100% airless spraying with the purchase of a plural component paint mixing and pumping system.

3.3 Phase III - Formalize Queuing Procedures

Queuing procedures, for the most part, were non-existent at the start of the FY-83 program. There was no scheduling of blast/'paint actions, no parts transfer paperwork, no adequate information on the part itself, . and no documented information on

what had to be done to the part. It was intended to establish queuing procedures so that it would be possible to apply labor standards to the work. The first need was to get control of what was happening. Several new forms were tried, as follows:

l Material Move Request (Appendices E and El) - this form would provide all the information needed on the job and would get the part moved to the blast/paint area. The information on the form would then be used by the blast/paint scheduler in filling out a Job Card.

l Job Card (Appendices F and F.1) - this form was filled out from information on the Material Move Request. The card was given to the worker at the start of the job, who filled in his name, clock number, time in and out, and the number of pieces.

l Material Move Request Form and Job Record (Appendix G) - this combination card was later tried at the request of the shop scheduler, in an attempt to adapt to the present system more effectively than with the two separate forms.

Ž UARCO (Appendix H) - this form is a material requisition form commonly used at PBI. Evaluation disclosed that it did not request all the information needed to apply a labor standard to the job.

Trial usage of the Material Move Request, the Job Card, and the

Material Move Request Form and Job Record revealed that they required a large amount of effort, particularly on the part of the scheduler. The Material Move Request was filled out by the sending department and was made up of three copies; one for the. sender, one for the part load, and one for the department receiving the parts. The Job Card also resulted in too much paperwork. Ordinarily a Job Card was needed for each part. A summary Job Card was considered for very short cycle jobs such as jobs with a cycle time of 0.3 hours and jobs with less than five pieces. Use of the UARCO form took less time than the others, but it did not contain all the information needed. Clearly, the time consumed by the overall forms effort indicated the need for a computerized routing system. Such a system was not in place, nor could it be established soon enough to benefit this project.

In view of the conditions surrounding the movement and handling of parts, and the absence of an acceptable format for obtaining information needed for applying labor standards, it was not possible to establish and implement effective queuing procedures.

3.4 Phase IV - Apply Labor Standards

The objectives of this Phase were to apply labor standards, monitor work performance, record problems, work up solutions to the problems, and make the necessary changes. This Phase overlapped somewhat into Phase III, as scheduling standards were

already being applied coincident with attempts to implement queuing procedures. Standard times were taken from pick-off charts (Appendices I through P). Information not available from the UARCO form was gained from other sources, but this action proved to be very time consuming.

The problems discovered in implementing the labor standards were: (1) insufficient lead time from when the parts were received to when they had to be completed; (2) inadequate information on the UARCO form to apply the labor standard to the job; and (3) inadequate records as to where the stock was located in the yard. These problems were treated, and some improvements were made on the first and third items. However, the UARCO form with its shortcomings, and the paperwork handled manually, were not conducive to the application of labor standards. For ship sections and large parts which were tracked closely, however, few problems were encountered.

Being unable to effectively implement labor" standards for loose parts, and seeing no immediate improvements in queuing procedures, the only recourse was to terminate the labor standards project in the blast/paint areas. This was done on July 17, 1984.

3.5 Phase V - Examine Delay Time

This Phase identified the delay times observed in Phase I and Phase IV. The objective was to isolate delay times, investigate the reasons for the delays, and find solutions that would eliminate or at least reduce the lost time. Each delay was given a thorough review toward reducing the impact on job performance.

The non-process factor is made up of the remaining unavoidable delays and is a separate add-on to the standard (Appendix Q). The non-process factor accounts for real and acceptable differences between level times and actual times to accomplish the work. In the blasting area the non-process factor amounted to 10.8%. In the loose parts painting area the non-process factor was 8.4%. Some of the delays in the blasting area were a result of scheduling difficulties, and recurring problems with the large doors to the booth. The scheduling difficulties have lessened somewhat, but the door problem persists and will probably require door replacement.

In the loose parts painting area, the delays which had to do with the painting of loose parts involved substantial time for parts to air dry, along with excessive handling time. In addition, the laying out of parts on 4' X 8' plywood sheets created very conjested working conditions' in the shop. A drying oven was installed to speed up the drying cycle time. While previously six to eight hours was required to air dry a part, oven drying

time is only ten minutes. Oven drying proved to be an effective approach to the elimination of most of the drying delay time, and stepped up productivity at least thirty-eight times faster.

Another productivity improvement resulting from delay time examination was the purchase of a plural component proportioning system for mixing paint. This system reduced mixing and cleaning time, supported airless spraying equipment, and reduced paint waste in mixing. These improvements appear as benefits from the program (paragraph 4).

3.6 Phase VI - Refine Application Procedures

The object of this Phase was to simplify the method of applying labor standards based on experience gained during the trial period, and ‘co instruct planners and schedulers in techniques for applying labor standards. This Phase is a take-off and refinement of Phase IV to further improve application procedures. This Phase was not reached because the project was terminated.

3.7 Phase VII - Evaluate Cost Effectiveness

A brief evaluation of costs to apply labor standards vs. savings from the application of labor standards was made, even though the project had to be terminated. Costs for this type of program must be viewed in the long run, because initial costs are bound to be high. In this specific case, continuing on despite major

implementation difficulties clearly was not cost effective. Depending on the results of the companion effort at PBI to apply labor standards in the electrical area, the future may hold another attempt to treat the blast/paint areas. By that time, and based on experience gained both during this projec″t and the companion electrical project, implementation may be more manageable.

4. Overview, Conclusions, and Benefits

4.1 Overview

From the start of this project, the implementation of labor standards in the blast/paint areas was viewed with some reservation. The concern at hand was not that the implementation of labor standards was technically unfeasible, but rather that establishing the changes needed to allow for a suitable implementation program would be difficult. The lack of any formal system at PBI to move parts to the blast/paint areas was recognized as an initial condition, as was the lack of readily available information needed to identify the parts in order to establish the labor standards. These concerns were expressed in several of the Monthly Progress Reports on this project. There was also some question as to whether the application of labor standards would generate enough savings to cover the application costs. The following conditions were identified which could adversely affect the implementation of

labor standards. in the blast/paint areas:

- Lack of formal scheduling of work to these facilities.
- Absence of an adequate tracking system for loose parts.
- Scarcity of information on actual job performance.
- Lack of a formal yard transportation system with dependable movement of parts.

These conditions impact the application of labor standards, and the resulting problems were amplified because 80% of the total blast/paint work goes through the loose parts painting area. Forms and procedures were developed and implemented in an attempt to combat these conditions, but proved to be too time consuming and had to be abandoned.

Faced with the inability to remedy the existing conditions, and seeing no immediate opportunity for substantial improvements like the introduction of a computerized routing system, the balance of the project to implement labor standards in the blast/paint areas was terminated on July 17, 1984.

4.2 Conclusions

Although the full project was not carried to completion, several conclusions were reached relative to the implementation of labor standards:

- A routing system (preferably computerized) is essential to control the movements of, and provide information on, the large volume of individual parts (about 80% of the total items) encountered in the blast/paint areas. Such a system would make queuing procedures workable, and thereby support the efficient application of labor standards with attendant savings in productive effort.

- The sampling techniques employed, in combination with the insight gained into productive work by means of the labor standards, proved to be both efficient and effective in highlighting major problem areas (e.g. excessive air drying time; excessive paint mixing and cleaning time) leading directly to corrective actions (e.g. drying oven; plural component proportioning system for mixing paint).

- Labor standard data needs periodic updating to accommodate changes in production procedures and equipment, some of which are subtle and may be unnoticed unless and until a formal investigation is made.

The classical advantages of applying labor standards to production work are real, valuable, and dynamic. An effective labor standards program provides improved knowledge about the productive processes, which enables improvements in the credibility of planning scheduling, estimating, manpower loading, and overall productivity targets. Workers and supervisors have a reliable guide to reasonable performance, and those supporting and controlling production have a reliable performance reference on which to base their involvements.

4.3 Benefits

Although the project was terminated before extensive labor standards implementation in the blast/paint areas was realized, several major benefits resulted directly from this project:

c The paint drying oven, installed in July 1984, provides greatly improved productivity, reduced waiting time, and improved accessibility to the paint booth area for ship sections and loose parts (by elimination of air drying tables). The cost to paint loose parts has dropped substantially. On a three shift operation at the current cost reduction rate, estimated yearly savings would be $176,505.00. In addition, what was once a critical backlog of unpainted parts is now a one-to-two day turnaround for parts dried in the oven.

- Installation of a plural component proportioning system to handle two part epoxy paint mixing has produced savings estimated at $24,000.00 per year. This is largely due to less paint waste, reduced mixing time, and use of an airless spraying system.

l If labor standards had been fully implemented in the blast/paint areas, the overall savings are estimated to exceed 35% or $109,200.00 per year.

l The assignment of a scheduler to the blast/paint area, and the resultant prescheduling of parts~ has provided better control over parts coming to the blast/paint booths.

l Labor standards data from this project will be directly applicable to a project now in progress "The Economics of Shipyard Painting", for the 023-1 Panel of the SNAME Ship Production Committee under the MarAd National Shipbuilding Research Program.

GLOSSARY

Baseline Data - The masure of the efficiency rate and performance level in the departxnsnt (within or outside the shop) at the current time before there are any changes or implemmtation of a labor standards program to improve the productivity of this department.

Standard Data - Asetof synthesized time values established using the MOST technique.

Labor Standards - A combination cf standard data setup in an organized pattern to cover work content.

Process with Value Added- 1s any physical change that takes place to the product, i.e., painting, blasting a profile on material, bolttig two pieces together, etc.

Process withoutValueAdded - 1s any supporting activity to the process that deem't physically change a product, i.e., setup and tear down equipment, operator leading and unloading parts, etc.

Avoidable Delay - A delay which is under the control and responsibility of the worker (i..e., wasting time, inefficient or irnprope rworkmethod).

Unavoidable Delay - A delay vdich is outside the control or responsibility of the work (i.e., receive instructions, cleanup).

Non-Process Time - The time spent by workers while engaged in activities outside the basic process (personal tire, waiting for material, equipment breaki@n, delays, etc.).

Non-Process Factor - A factor developed to take into account the real, natural and acceptable differences between level times and actual times for accomplishing work. The mgnitude of the non-process factor is based on a work sampling conducted at the work place.

APPENDIX INDEX

Appendix A

Peterson Builders, Inc.
General Operating Procedures
Blast and Paint Shops

This Appendix describes the general operating procedures used in the Blast and Paint Shops.

A.1 Transfer

A.1.1 All loose parts to be blasted and/or painted shall be accompanied by a UARCO form filled out with the following information (see Appendix H of this Report for a sample UARCO form).

1 - Contract No. (use WORK ORDER NO. space)
2 - Date of Transfer (DATE)
3 - Drawing No. (DRWG. NO.)
4 - Date Required (DATE REQ'D.)
5 - Hull No. (use space at top of form)
6 - Department originating the transfer (DEPT.)
7 - Part No. (PIECE NO.)
8 - Number of pieces for each part (QUAN.)
9 - Directions to blast/paint the parts (use ITEMS space)
10 - Destination after blast\paint (use ITEMS space)
11 - Preparer's Signature (BY)

A.1.2 The UARCO form is filled out by the Department requesting the parts to be blasted and/or painted. This Department should call the Paint Shop (Ext 159) and ask for the Leadman in charge of scheduling (Bruce Jorgensen). The Leadman/Scheduler will indicate when the material may be delivered to the Paint Shop (or associated storage area). When the material arrives at the Paint Shop it must be accompanied by a properly filled out UARCO form. The Leadman/Scheduler uses the information on the UARCO form for scheduling the material within the shop.

A.2 Material Handling

A.2.1 Material is stored on racks in the designated paint storage area, or (if there is room) in the blast or paint booths. Material is brought into the blast/paint area by one of five ways; by hand, cartl forklift, Go-Devils, or on a jig (as with large sections).

A.2.1.1 Material brought in by hand is loaded directly onto tables.

A.2.1.2 Material brought in by cart is usually left on the cart inside the Paint Shop.

A.2.1.3 Material brought in by forklift is left on its pallet or in its tote pan, or may be a single part moved into the shop by the forklift.

A.2.1.4 Material brought in by Go-Devil is loaded on racks (side shells and plates) or on large stands (tanks and other large bulky-shaped items).

A.2.I.5 Large sections are set on a jig which is pushed/pulled by tractors and/or Go-Devils. The Building Maintenance Crew is called in to open the doors of the Blast or Paint Shop. The section on the jig is moved into the building where it is blocked and left for blasting/painting.

A.3 Blasting

A.3.1 Small parts (under 30#) are loaded on a steel grate table. Larger parts are left on their pallets or on the floor. The material is blasted to a near white to obtain the proper mil profile, or else sweep blasted (if previously blasted and having a coat of shop primer). (Note: Sweep blasting is for cleaning the material of light rust and dirt. It is not intended for applying a profile to the material.)

A.4 Clean Up

A.4.1 Individual parts

The material is blown off using an air hose to remove the grit left after blasting. The vacuum recovery unit is used to vacuum up the grit that collects inside tight spots and to replenish the supply of grit to the blasters. The material is then transported to the Paint Shop by the same means it was delivered to the blast booth. Note: If a scheduling problem or bad weather occurs, the material can be painted in the blast booth.

A.4.2 General Area

When grit in the hoppers runs low, or before and after removal of a large section on a jig, grit is picked up off the floor and dumped at the conveyor opening by a small front-end loader. The remaining grit is swept into a pile by a power brush, and then moved to the conveyor opening by a small front-end loader. The conveyors are turned on, and the operators check for larger contaminants that may clog the conveyor. When the hoppers have been filled to the top of the window plate, the conveyors are turned off. Note: Hoppers must not be filled past the top of the window plate because the grit will overflow into the waste barrel.

A.5 Painting

A.5.l In the paint booth, loose parts and large sections are painted by one of five ways; dipping, brushing, rolling, conventional Spraying, and airless spraying. Areas to be masked, such as joint edges or other specified surfaces, are covered with masking tape before paint is applied. The masking tape is removed as soon as the paint is dry to the touch and does not easily scratch off by hand.

A.5.1.1 Dip Painting

Only very small parts in large quantity are dipped. They are placed in a dipping basket, dipped into the paint, and then spread out over a screen mesh.

A.5.1.2 Brush Painting

Brush painting is only used for touch up in the Paint Shop. Paint is applied by brush to areas that have been scratched, missed, have runs, etc., and to apply shop primer over welds and edges that were masked off for fit up.

A.5.l.3 Roller Painting

Painting with a roller is used for the application of fire retardant paint to wood, or vapor barrier paint to insulated duct work.

A.5.1.4 Conventional Spraying

Conventional spray painting is used when a small quantity of paint is needed, usually two quarts or less. Loose parts are painted on one side. When dry, they are turned over and a coat of paint is applied to the other side. This process is repeated until the required number of coats have been applied.

A.5.l.5 Airless Spraying

Airless spraying is the process used most often for large quantities of loose parts, large sections, side shells plates, tanks, etc., which are to be painted with the same type of paint. The paint is applied and checked periodically for the recommended mil thickness. The number of coats applied depends on the painting schedule and contract specifications.

A.6 Drying

A.6.1 Air Drying

All large sections air dry because of their size. Loose parts are left to air dry on the pallets or four-wheel carts where they were painted, or are laid out on tables made up

of bucks, 2" X 4"sr and 4' X 8' pieces of plywood.

A.6.2 Oven Drying

Loose parts are loaded on aluminum carts which move on a track in and out of the oven. The parts are then painted, and the operator starts the painting/drying cycle. .The doors open on the oven, and one cart goes into the oven as one cart comes out of the oven. The oven doors close and the timer resets for ten minutes. This process is repeated until the specified number of coats have been applied to the parts.

A.7 Painting Procedure - Paint Booth

A.7.1 Set Up Procedure for the Painter

A.7.l.l Equipment for personal protection

The operator wears gloves, coveralls, earplugs, mask, helmet liner, hardhat, and safety glasses.

A.7.1.2 Set Up Operator

Put on coveralls, safety glasses, and hardhat. When working in a place with excessive noisel wear earplugs. When painting, wear a mask with helmet liner and gloves (optional).

A.7.2 Conventional Painting Equipment

A.7.2.l Toola

1 - Crescent wrench
2 - Screwdriver
3 - Putty knife
4 - Wst mil gauge
5 - Rags

A.7.2.2 Equipment

1 - Pressure pot
2 - Spray gun
3 - Air hose

A.7.2.3 Set Up Conventional Equipment

1 - Set up pressure pot.
2 - Use crescent wrench to loosen four wing nuts.
3 - Remove cover and set aside.
4 - Place screen in pressure pot.
5 - Pour mixed paint through screen into pressure pot and set aside paint can.
6 - Remove screen and rinse in thinner tank.
7 - Place cover on pressure pot.

8 - Hand tighten four wing nuts on cover evenly.
9 - Tighten four wing nuts evenly with crescent wrench.
10 - Attach air hose to pressure pot.
11 - Turn lever to pressurize the pot and feel for air leaks. If there are no air leaks, the pressure pot is set up correctly. If there are air leaks, disconnect air supply and repeat steps 9, 10, and 11.

A.7.2.4 Set Up Spray Equipment

1 - Uncoil air hose and paint hose and remove any twists or kinks.
2 - Fasten airline and paint hose to pressure pot using wrench.

A.7.2.5 Teardown and Clean Pressure Pot

1 - Turn off air supply at pressure pot.
2 - Disconnect air hose from pressure pot.
3 - Slowly open valve at pressure pot to release air pressure in pot.
4 - Loosen four wing nuts with crescent wrench or suitable tool.
5 - Remove cover from pressure pot.
6 - Dump paint out of pot into waste bucket.
7 - Use rag with thinner and wipe out pot and inside of cover.
8 - Pour about 1/3 gallon of thinner into pot.
9 - Place cover on pot and tighten four wing nuts.
10 - Connect air hose to pressure pot.
11 - Turn on valve to pressurize pot.
12 - Spray paint into waste bucket until only thinner comes out. Then spray into waste thinner bucket, occasionally covering spray tip with rag until the thinner is used up.
13 - Turn off air at pressure pot.
14 - Disconnect air hose from pressure pot.
15 - Repeat steps 3, 4, and 5.
16 - Wipe out pot and cover with rag.
17 - Replace cover and tighten four wing nuts by hand.
18 - Loosen air line and paint hose connection to spray gun.
19 - Place spray gun in thinner.
20 - Coil air hose and paint hose around pressure pot and return to storage.

A.7.2.6 Set Up Spray Gun

1 - Uncoil air hose and paint hose and straighten, removing any twists or kinks.
2 - Fasten air hose and paint hose to pressure pot using wrench.

3- Fasten air hose and paint hose fittings to spray gun.
4- Turn on air lever and paint lever at pressure pot.
5- Test spray pattern on spray gun. "Adjust spray pattern using two knobs on spray gun to 12" fan.

A.7.3 Airless Spray Painting

A.7.3.1 Set Up Airless Sprayer

1 - Select correct spray tip for the paint application.
2 - Attach spray tip to airless spray gun with a crescent wrench.
3 - Place siphon tube in paint bucket.
4 - Connect air supply to the airless sprayer.
5 - Place spray gun in waste bucket and spray into bucket until all the thinner is forced out of the paint line, and paint is visibly coming out.
6 - Check for leaks and test spray pattern by depressing trigger, and visually inspect pattern.

A.7.3.2 Clean Up Airless Sprayer

1 - Turn off air at airless sprayer.
2 - Pull lever at airless sprayer to release air pressure.
3 - Remove spray tip using a crescent wrench and set aside.
4 - Using a rag and thinner pail, remove siphon tube from paint bucket, wipe siphon tube with rag, and place siphon tube in thinner pail.
5 - Turn on air at airless sprayer.
6 - Spray into waste pail. This will empty the paint hose of paint, and fill the hose with thinner.
7 - Disassemble spray tip for cleaning using a screwdriver.
8 - Spray the spray tip with thinner from the spray gun until the spray tip is clean.
9 - Assemble spray tip and set aside.
10 - Disconnect air hose from airless sprayer.
11 - Release pressure from spray gun by pulling the trigger.
12 - Remove the filter cap.
13 - Take filter apart and replace cap.
14 - Connect air hose to airless sprayer.
15 - Using spray gun, clean filter and inner filter.
16 - Disconnect air hose from airless sprayer.
17 - Remove filter cap and place inner filter and filter in filter cap.

18 - Connect filter and inner filter to airless sprayer.
19 - Remove siphon tube from thinner bucket and place in siphon holder.

A.7.3.3 Mixing Paint - Two Part

1 - Mix paint - two part
2 - Open paint can cover using a screwdriver.
3 - Place air mixer in thinner tank.
4 - Operate air mixer in thinner tank to clean mixer.
5 - Place mixer in paint and operate mixer for about 30 seconds to mix paint.
6 - Move mixer from paint to thinner tank and operate mixer in thinner to clean.
7 - Remove inner pail from two-part paint can with pliers and set on floor.
8 - Get mixer from thinner tank and mix paint for 30 seconds.
9 - Pour specified amounts of paint into paint can.
10 - Mix two part paint with mixer for about 30 seconds.
11 - Place mixer in thinner tank and operate a few seconds to clean it.
12 - Pick up inner pail with pliers and place in paint can.
13 - Place cover on paint can and tighten with screwdriver or putty knife.

A.7.3.4 Mix Paint - One Part

1 - Open can by removing cover with screwdriver or putty knife.
2 - Place mixer in thinner tank and operate mixer for 5 seconds.
3 - Move mixer to paint pail and mix paint for 30 seconds.
4 - Place mixer into thinner tank and operate mixer for 5 seconds.
5 - Pour paint into paint can.
6 - Place cover on paint can and tighten with screwdriver or putty knife.

A.7.4 Plural Component System

A.7.4.1 Plural Component System - Set Up

1 – Make sure lever at the incoming air regulator at back of system is turned clockwise to off.
2 – Turn air regulator all the way out.
3 – Slowly turn on air.

4- Tuzn air regulator in so that the gauge reads 80 PSI.
5- Turn lever to ON (down) at both paint pumps.
6- Make suze thinner valve is shut (turn clockwise).
7- Make sure both needle valves are turned all the way in to the closed position.
8- Push double valve lever forward.
9- Check two pump regulators to make sure they are at the same setting.
10 - Plural component system is ready to use for spraying.

A.7.4.2 Plural Component System - Teardown

1 - Back out main air regulator until the gauge points to zero PSI and pressure is released.
2 - After pressure is released, pull double valve lever back to close paint valves.
3 - Open thinner valve (turn counter-clockwise).
4 - Turn on thinner pump (turn lever down).
5 - Open one needle valve (make sure the other needle valve is closed).
6 - Run thinner through until all the paint is out of the line.
7 - Close first needle valve.
8 - Open second needle valve.
9 - Run thinner through lines until all the paint is out.
10 - Open first needle valve.
11 - Run thinner through both lines.
12 - Close thinner valve (turn lever clockwise).
13 - Turn off main air supply to plural component system.

A.7.4.3 Change Paint Drums on Plural Component System

1- Disconnect air hose from agitator and connect it to piston.
2 - Wait for agitator and pump to raise.
3 - Turn agitator and pump 18~ degrees over other drum.
4 - Pull lever and guide agitator and pump into new drum.
!5 - Disconnect hose from piston and connect to agitator.

A.8 Drying Oven

A.8.1 Drying Oven - Start

1 - Turn on waterfalls #5 and #6. (Note: Oven cannot be started unless waterfalls are on.)

2 - Turn master switch to ON at control panel in the power room between Blast and Paint Shops.
3 - Push START button on control panel.
4 - Wait until OVEN. PURGE (blue) light comes on.
5 - Push HEAT button.
6 - Temperature is set at 250 degrees - do not change.
7 - Load parts on table at oven.
8 - Spray parts on table.
9 - Push CYCLE START button at oven and align table with paint mark on floor and release.
10 - Timer is set for 10 minute cycle. (Epoxies take 10 minutes to dry; enamels take 3 minutes to dry).
11 - The oven automatically opens and closes doors and moves carts on the track.
12 - Repeat cycle when light comes on.

A.9 Blast Procedure - Blast Booth

A.9.1 Set Up Procedure for Blasting

A.9.1.1 Set Up Operator

1 - Put on coveralls.
2 - Tape wrists and ankles of coveralls.
3 - Put in earplugs.
4 - Put on hardhat liner.
5 - Place blasting helmet on head.
6 - Put on gloves.

A.9.I.2 Set Up Blasting Equipment

1 - Turn on two blowers, push START button for each blower.
2 - Turn on two hoppers, push START button and turn on power switch.
3 - Fill hopper to top of glass window of hopper.
4 - Turn off hopper, push STOP button and turn off power switch.
5 - Turn on main air lever.
6 - Turn on air valve at hopper inside blast booth for switch on blast nozzle.
7 - Turn on air valve for fresh air in helmet located by the blaster.
8 - Turn on switch and push button for light at blast nozzle.

A.9.1.3 Teardown Blaster

1 - Turn off switch and push button to turn off light at blast nozzle.
2 - Remove helmet and turn off air valve for fresh air.
3 - Turn off air valve at hopper inside blast booth.

4 - Turn off main air lever.

A.9.2 Vacuum Recovery System

A.9.2.1 Set Up System

1 - Turn on air, move lever in up position.
2 - Turn on power.
3 - Push START button.

A.9.2.2 Teardown System

1 - Push OFF button.
2 - Turn off power.
3 - Turn off air, move lever down.

A.9.2.3 Clean Out Vacuum

1 - Open bottom hatch - turn counter-clockwise.
2 - Scrape out inside with scraper.
3 - Close bottom hatch - turn clockwise.
4 - Clean out waste bucket and replace.

BASELINE DATA SHEET FOR BLASTING

. D. W,

FILE

BLASTING

ENG.

TIME OF OBSERVATION

ANALYSIS FORM

1	PROCESS-VALUE ADDED
2	Blasting
3	
4	
5	
6	
7	
8	PROCESS WITHOUT
9	VALUE ADDED
10	Vacuum Grit
11	Clean Grit from Floor
12	Blow OffGrit
13	Masking & Removal
14	Load & Unload
15	Turnover Parts
16	Setup & Teardown Equip
17	Setup & Teardown Op.
18	Instructing or Receiving
19	Walking
20	
21	
22	
23	
24	
25	PERSONAL, FATIGUE & DELAY
26	Personal
27	Fatigue
28	UNAVOIDABLE DELAY
29	Clean up
30	
31	
32	
33	
34	
35	A[redacted]AY
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APPENDIX B

BASEINE DATA SHEET FOR PAINTING

P. P. 2163 — FILE

PAINTING — ENG.

DAIC Snccl

TIME OF OBSERMTON

ANALYSIS FORM

1	PROCESS-VALUE ADDED
2	Spray Painting
3	Paing with Roller
4	Paint with Brush
5	Dipping Parts
6	
7	
8	PROCESS WITHOUT
9	VALUE ADDED
10	Get + Mix Paint
11	Blow Off Dirt & Grit
12	Masking & Removal
13	Turn Over Parts
14	Load & Unload
15	Setup & Teardown equip.
16	Setup & Teardown Op.
17	Setup Tables
18	Instructing or Receive
19	
20	
21	
22	
23	
24	
25	PERSONAL, FATIGUE & DELAY
26	Personal
27	Fatigue
28	UNAVOIDABLE DELAY
29	Clean up
30	
31	
32	
33	
34	
35	AVOIDABLE DELAYS
36	
37	
38	
39	
40	
41	
42	
43	
44	
45	
46	Rummaging in Ukr
47	Out of Shop

APPENDIX C

APENDIX D

PRODUCT MIX SHEET

ANALYSIS FORM 1038A
P. D. 2X6

DATE

	PART NO. OR IDENTIFICATION	HOW IDENTIFIED	PART DESCRIPTION AND SIZE OF PART	INSTRUCTIONS & HOW IDENTIFIED AFTER BLASTING	NO. OF PIECES	AREA OF SEC.	TIME MATERIAL BROUGHT IN/OUT	WHICH DEPT.	WHERE IT GOES?	WHERE RECEIVED INSIDE/OUTSIDE	LOAD AND	UNLOAD PARTS	SET EQUIPMENT	TIME TO BLAST	LABOR STANDARD	EFFICIENT	DELAYS	
1																		
2																		
3																		
4																		
5																		
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36																		

MATERIAL MOVE REQUEST

In an effort to initiate improvements to obtain better control of the handling of loose parts through the blasting and painting operations, a Material Move Request card is being proposed.

The Material Move Request card is a record of the movement of parts between departments. It is composed of three copies, the first two are reproducing copies that duplicate the information written on the first copy to the second and third. The third copy is a tag to be attached to the material for identification by the sending department. The first copy is given to the move man (trucker) by the sending department. The trucker passes it on to the scheduler in the department receiving the parts. The second copy is retained by the sender for his records. Each skid load to have a separate material move request.

The purpose of the Material Move Request is to:

1) Authorize the move of materials between departments.
2) Inform the department receiving the Material Move Request that they have the parts to work on.
3) The sending department has a record of when and where the parts were sent. The two departments have records and know where the material is.
4) The card copy identifies the material at all times should it get lost.
5) The scheduler receiving the first copy can proceed to schedule the work per the requested completion date.
6) Better flow of material through the department is possible as the work can be scheduled in a systematic way to satisfy time dates for following operations.
7) Will be used to provide information to fill out a job card to do the work.

. MATERIAL MOVE REQUEST No.

PART NO.	PART NAME	DATE
HULL No.		QTY
MATERIAL DESCRIPTION		
DEPT. NO AND EXPEDITORS EXT.		DATE MAT'L REQ'D
MOVE MATERIAL FROM	TO	BY

MOVE MAN - GIVE THIS COPY TO PRODUCTION SCHEDULER

MATERIAL MOVE REQUEST No.

PART No .	Part NAME	DATE
HULL No.		QTY
MATERIAL DESCRIPTION		
DEPT. NO AND EXPEDITORS EXT.		DATE MAT'L REQ'D
MOVE MATERIAL FROM	TO	BY

THIS COPY IS RETAINED BY SENDING DEPT.

MATERIIAL MOVE REQUEST No.

PART NO.	PART NAME	DATE
HULL NO.		QTY
MATERIAL DESCRIPTION		
DEPT. NO AND EXPEDITORS EXT.		DATE MAT'L REQ'D
MOVE MATERIAL FROM	TO	BY

THIS COPY TO BE ATTACHED TO PART - LOAD

BLAST/PAINT JOB CARD

The job card is a record of the work accomplished on a job. It also provides information about the job to the worker.

The top section of the job card is filled in by the Scheduler, whereas the bottom section is filled in by the worker.

The job card would have two copies. The first a paper copy will reproduce the second, a card copy. The first copy is retained by the Scheduler as a record of the status of the job. The second copy goes to the worker authorizing that person *to* do the job. All job cards on jobs whether completed or not are turned in at the end of the shift. Only the number of parts completed should be indicated on the job card. The Scheduler is to have the next days job cards ready at the start of the shift, which will include a new job card for a job over eight hours.

The purpose of the job card is to:

1) Provide information to establish work schedules and set up priorities.
2) Give the worker knowledge of what must be done on the job.
3) Provide information of work completed and who did the job.
4) Inform the Scheduler when to move the job to the next department and initiate the Material Move Request.

This job card can serve other purposes such as provide information that can be used for supervisory and management reports.

JOB CARD

BLAST/PAINT	DATE
PART NO.	HULL NO.
PART DESCRIPTION	QTY
OTHER IDENTIFICATION	

PROCESS - BLAST

PAINT-COLOR PRIME #	# COATS
PAINT-COLOR FINISH #	# COATS
OTHER WORK	METHODS CODE

JOB FINISH TIME

JOB START TIME

FOREMAN USED	TOTAL TIME

EMPLOYEE'S NAME

CLOCK #	DEPT #	QTY FINISHED

MATERIAL MOVE REQUEST FORM AND JOB RECORD

MATERIAL MOVE REQUEST FORM TO BLAST/PAINT SHOPS

FROM DEPT. NO.		TO DEPT.		RETURN TO DEPT.		
WORK ORDER NO.		HULL NO.		DATE	DATE REQ'D	
DRWG. NO.		TYPE OF PAINT ---->				

NO OF PIECES	SIZE OF PIECE	LENGTH OF EACH PIECE	DESCRIPTION OF PART	ACTUAL TIME	BLAST STANDARD	PAINT STANDARD 1st COAT	PAINT STANDARD 2nd COAT
			TOTAL TIME				

CLOCK NO | By: | EXT.

APPENDIX G

U A R C O

ORIGINAL

PETERSON BUILDERS, INC.

MATERIAL REQUISITION ☐ YfORK REQUISITION ☐

WORK ORDER NO. _____ DATE _____

DRWG. NO. _____ DATE REQ'D. _____

CLOCK NO.	WHSE.	DEPT.	NOT ON B.P.L.	CHARGE	CREDIT

PIECE NO.	QUAN.	ITEMS

No. 342964
Uarco Business Forms

BY _____

APPENDIX H

TIME STANDARDS FOR BLASTING LOOSE PARTS

Area of table Covered by part	SQ FT		
(No. Parts)	.0164	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0199	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0259	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0294	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0329	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0364	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0399	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0434	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0469	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0504	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0539	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0574	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0609	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0644	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0679	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0724	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0749	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0784	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0819	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0854	=	Standard

Area of table Covered by part	SQ FT		
(No. Parts)	.0889	=	Standard

TIME STANRARDS FOR BLASTING

BLAST LARGE SECTIONS

SWEEP BLAST

AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS
10	0.0167	510	0.8517	1010	1.6867	1510	2.5217	2010	3.3567	2510	4.1917
20	0.0334	520	0.8684	1020	1.7034	1520	2.5384	2020	3.3734	2520	4.2084
30	0.0501	530	0.8851	1030	1.7201	1530	2.5551	2030	3.3901	2530	4.2251
40	0.0668	540	0.9018	1040	1.7368	1540	2.5718	2040	3.4068	2540	4.2418
50	0.0835	550	0.9185	1050	1.7535	1550	2.5885	2050	3.4235	2550	4.2585
60	0.1002	560	0.9352	1060	1.7702	1560	2.6052	2060	3.4402	2560	4.2752
70	0.1169	570	0.9519	1070	1.7869	1570	2.6219	2070	3.4569	2570	4.2919
80	0.1336	580	0.9686	1080	1.8036	1580	2.6386	2080	3.4736	2580	4.3086
90	0.1503	590	0.9853	1090	1.8203	1590	2.6553	2090	3.4903	2590	4.3253
100	0.1670	600	1.0020	1100	1.8370	1600	2.6720	2100	3.5070	2600	4.3420
110	0.1837	610	1.0187	1110	1.8537	1610	2.6887	2110	3.5237	2610	4.3587
120	0.2004	620	1.0354	1120	1.8704	1620	2.7054	2120	3.5404	2620	4.3754
130	0.2171	630	1.0521	1130	1.8871	1630	2.7221	2130	3.5571	2630	4.3921
140	0.2338	640	1.0688	1140	1.9038	1640	2.7388	2140	3.5738	2640	4.4088
150	0.2505	650	1.0855	1150	1.9205	1650	2.7555	2150	3.5905	2650	4.4255
160	0.2672	660	1.1022	1160	1.9372	1660	2.7722	2160	3.6072	2660	4.4422
170	0.2839	670	1.1189	1170	1.9539	1670	2.7889	2170	3.6239	2670	4.4589
180	0.3006	680	1.1356	1180	1.9706	1680	2.8056	2180	3.6406	2680	4.4756
190	0.3173	690	1.1523	1190	1.9873	1690	2.8223	2190	3.6573	2690	4.4923
200	0.3340	700	1.1690	1200	2.0040	1700	2.8390	2200	3.6740	2700	4.5090
210	0.3507	710	1.1857	1210	2.0207	1710	2.8557	2210	3.6907	2710	4.5257
220	0.3674	720	1.2024	1220	2.0374	1720	2.8724	2220	3.7074	2720	4.5424
230	0.3841	730	1.2191	1230	2.0541	1730	2.8891	2230	3.7241	2730	4.5591
240	0.4008	740	1.2358	1240	2.0708	1740	2.9058	2240	3.7408	2740	4.5758
250	0.4175	750	1.2525	1250	2.0875	1750	2.9225	2250	3.7575	2750	4.5925
260	0.4342	760	1.2692	1260	2.1042	1760	2.9392	2260	3.7742	2760	4.6092
270	0.4509	770	1.2859	1270	2.1209	1770	2.9559	2270	3.7909	2770	4.6259
280	0.4676	780	1.3026	1280	2.1376	1780	2.9726	2280	3.8076	2780	4.6426
290	0.4843	790	1.3193	1290	2.1543	1790	2.9893	2290	3.8243	2790	4.6593
300	0.5010	800	1.3360	1300	2.1710	1800	3.0060	2300	3.8410	2800	4.6760
310	0.5177	810	1.3527	1310	2.1877	1810	3.0227	2310	3.8577	2810	4.6927
320	0.5344	820	1.3694	1320	2.2044	1820	3.0394	2320	3.8744	2820	4.7094
330	0.5511	830	1.3861	1330	2.2211	1830	3.0561	2330	3.8911	2830	4.7261
340	0.5678	840	1.4028	1340	2.2378	1840	3.0728	2340	3.9078	2840	4.7428
350	0.5845	850	1.4195	1350	2.2545	1850	3.0895	2350	3.9245	2850	4.7595
360	0.6012	860	1.4362	1360	2.2712	1860	3.1062	2360	3.9412	2860	4.7762
370	0.6179	870	1.4529	1370	2.2879	1870	3.1229	2370	3.9579	2870	4.7929
380	0.6346	880	1.4696	1380	2.3046	1880	3.1396	2380	3.9746	2880	4.8096
390	0.6513	890	1.4863	1390	2.3213	1890	3.1563	2390	3.9913	2890	4.8263
400	0.6680	900	1.5030	1400	2.3380	1900	3.1730	2400	4.0080	2900	4.8430
410	0.6847	910	1.5197	1410	2.3547	1910	3.1897	2410	4.0247	2910	4.8597
420	0.7014	920	1.5364	1420	2.3714	1920	3.2064	2420	4.0414	2920	4.8764
430	0.7181	930	1.5531	1430	2.3881	1930	3.2231	2430	4.0581	2930	4.8931
440	0.7348	940	1.5698	1440	2.4048	1940	3.2398	2440	4.0748	2940	4.9098
450	0.7515	950	1.5865	1450	2.4215	1950	3.2565	2450	4.0915	2950	4.9265
460	0.7682	960	1.6032	1460	2.4382	1960	3.2732	2460	4.1082	2960	4.9432
470	0.7849	970	1.6199	1470	2.4549	1970	3.2899	2470	4.1249	2970	4.9599
480	0.8016	980	1.6366	1480	2.4716	1980	3.3066	2480	4.1416	2980	4.9766
490	0.8183	990	1.6533	1490	2.4883	1990	3.3233	2490	4.1583	2990	4.9933
500	0.8350	1000	1.6700	1500	2.5050	2000	3.3400	2500	4.1750	3000	5.0100

TIME STANDARDS FOR BLASTING

BLAST LARGE SECTIONS

FULL BLAST

AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS
10	0.0278	510	1.5198	1010	3.0098	1510	4.4998	2010	5.9898	2510	7.4798
20	0.0596	520	1.5496	1020	3.0396	1520	4.5296	2020	6.0196	2520	7.5096
30	0.0894	530	1.5794	1030	3.0694	1530	4.5594	2030	6.0494	2530	7.5394
40	0.1192	540	1.6092	1040	3.0992	1540	4.5892	2040	6.0792	2540	7.5692
50	0.1490	550	1.6390	1050	3.1290	1550	4.6190	2050	6.1090	2550	7.5990
60	0.1788	560	1.6688	1060	3.1588	1560	4.6488	2060	6.1388	2560	7.6288
70	0.2086	570	1.6986	1070	3.1886	1570	4.6786	2070	6.1686	2570	7.6586
80	0.2384	580	1.7284	1080	3.2184	1580	4.7084	2080	6.1984	2580	7.6884
90	0.2682	590	1.7582	1090	3.2482	1590	4.7382	2090	6.2282	2590	7.7182
100	0.2980	600	1.7880	1100	3.2780	1600	4.7680	2100	6.2580	2600	7.7480
110	0.3278	610	1.8178	1110	3.3078	1610	4.7978	2110	6.2878	2610	7.7778
120	0.3576	620	1.8476	1120	3.3376	1620	4.8276	2120	6.3176	2620	7.8076
130	0.3874	630	1.8774	1130	3.3674	1630	4.8574	2130	6.3474	2630	7.8374
140	0.4172	640	1.9072	1140	3.3972	1640	4.8872	2140	6.3772	2640	7.8672
150	0.4470	650	1.9370	1150	3.4270	1650	4.9170	2150	6.4070	2650	7.8970
160	0.4768	660	1.9668	1160	3.4568	1660	4.9468	2160	6.4368	2660	7.9268
170	0.5066	670	1.9966	1170	3.4866	1670	4.9766	2170	6.4666	2670	7.9566
180	0.5364	680	2.0264	1180	3.5164	1680	5.0064	2180	6.4964	2680	7.9864
190	0.5662	690	2.0562	1190	3.5462	1690	5.0362	2190	6.5262	2690	8.0162
200	0.5960	700	2.0860	1200	3.5760	1700	5.0660	2200	6.5560	2700	8.0460
210	0.6258	710	2.1158	1210	3.6058	1710	5.0958	2210	6.5858	2710	8.0758
220	0.6556	720	2.1456	1220	3.6356	1720	5.1256	2220	6.6156	2720	8.1056
230	0.6854	730	2.1754	1230	3.6654	1730	5.1554	2230	6.6454	2730	8.1354
240	0.7152	740	2.2052	1240	3.6952	1740	5.1852	2240	6.6752	2740	8.1652
250	0.7450	750	2.2350	1250	3.7250	1750	5.2150	2250	6.7050	2750	8.1950
260	0.7748	760	2.2648	1260	3.7548	1760	5.2448	2260	6.7348	2760	8.2248
270	0.8046	770	2.2946	1270	3.7846	1770	5.2746	2270	6.7646	2770	8.2546
280	0.8344	780	2.3244	1280	3.8144	1780	5.3044	2280	6.7944	2780	8.2844
290	0.8642	790	2.3542	1290	3.8442	1790	5.3342	2290	6.8242	2790	8.3142
300	0.8940	800	2.3840	1300	3.8740	1800	5.3640	2300	6.8540	2800	8.3440
310	0.9238	810	2.4138	1310	3.9038	1810	5.3938	2310	6.8838	2810	8.3738
320	0.9536	820	2.4436	1320	3.9336	1820	5.4236	2320	6.9136	2820	8.4036
330	0.9834	830	2.4734	1330	3.9634	1830	5.4534	2330	6.9434	2830	8.4334
340	1.0132	840	2.5032	1340	3.9932	1840	5.4832	2340	6.9732	2840	8.4632
350	1.0430	850	2.5330	1350	4.0230	1850	5.5130	2350	7.0030	2850	8.4930
360	1.0728	860	2.5628	1360	4.0528	1860	5.5428	2360	7.0328	2860	8.5228
370	1.1026	870	2.5926	1370	4.0826	1870	5.5726	2370	7.0626	2870	8.5526
380	1.1324	880	2.6224	1380	4.1124	1880	5.6024	2380	7.0924	2880	8.5824
390	1.1622	890	2.6522	1390	4.1422	1890	5.6322	2390	7.1222	2890	8.6122
400	1.1920	900	2.6820	1400	4.1720	1900	5.6620	2400	7.1520	2900	8.6420
410	1.2218	910	2.7118	1410	4.2018	1910	5.6918	2410	7.1818	2910	8.6718
420	1.2516	920	2.7416	1420	4.2316	1920	5.7216	2420	7.2116	2920	8.7016
430	1.2814	930	2.7714	1430	4.2614	1930	5.7514	2430	7.2414	2930	8.7314
440	1.3112	940	2.8012	1440	4.2912	1940	5.7812	2440	7.2712	2940	8.7612
450	1.3410	950	2.8310	1450	4.3210	1950	5.8110	2450	7.3010	2950	8.7910
460	1.3708	960	2.8608	1460	4.3508	1960	5.8408	2460	7.3308	2960	8.8208
470	1.4006	970	2.8906	1470	4.3806	1970	5.8706	2470	7.3606	2970	8.8506
480	1.4304	980	2.9204	1480	4.4104	1980	5.9004	2480	7.3904	2980	8.8804
490	1.4602	990	2.9502	1490	4.4402	1990	5.9302	2490	7.4202	2990	8.9102
500	1.4900	1000	2.9800	1500	4.4700	2000	5.9600	2500	7.4500	3000	8.9400

TIME STANDARDS FOR PAINTING AND ONE MAN LOADING LOOSE PARTS

Area of table Covered by part	(No. Parts)	= Standard
SQ IN 0 to 3	.0007	
SQ IN 4 to 7	.0014	
SQ IN 8 to 15	.0015	
SQ IN 15 to 24	.0017	
SQ IN 24 to 32	.0020	
SQ IN 32 to 50	.0042	
SQ IN 51 to 90	.0058	
SQ IN 91 to 143	.0067	
SQ FT 1	.0074	
SQ FT 1.5	.0090	
SQ FT 2	.0103	
SQ FT 2.5	.012	
SQ FT 3	.0134	
SQ FT 3.5	.0151	
SQ FT 4	.0166	
SQ FT 4.5	.018	
SQ FT 5	.0196	
SQ FT 5.5	.0209	
SQ FT 6	.0228	
SQ FT 7	.0258	
SQ FT 8	.0287	

TIME STANDARDS FOR PAINTING LOOSE PARTS AND 2 MAN LOADING

Area of table Covered by part	SQ FT
(No. Parts) .0084	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0099	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0111	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0126	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0139	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0154	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0168	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0183	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0196	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0209	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0227	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0253	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0279	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0307	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0332	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0363	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0390	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0419	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0447	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0474	= Standard

Area of table Covered by part	SQ FT
(No. Parts) .0503	= Standard

TIME STANDARDS FOR PAINTING AND ONE MAN TUNING OVER LOOSE PARTS

Area of table Covered by part	SQ IN 0 to 3
(No. Parts) . 0003 = Standard	

Area of table Covered by part	SQ IN 4 to 7
(No. Parts) .0005 = Standard	

Area of table Covered by part	SQ IN 8 to 15
(No. Parts) .0007 = Standard	

Area of table Covered by part	SQ IN 15 to 24
(No. Parts) .0010 = Standard	

Area of table Covered by part	SQ IN 24 to 32
(No. Parts) .0013 = Standard	

Area of table Covered by part	SQ IN 32 to 50
(No. Parts) .0029 = Standard	

Area of table Covered by part	SQ IN 51 to 90
(No. Parts) .0042 = Standard	

Area of table Covered by part	SQ IN 91 to 143
(No. Parts) .0048 = Standard	

Area of table Covered by part	SQ FT 1
(No. Parts) .0053 = Standard	

Area of table Covered by part	SQ FT 1.5
(No. Parts) .0066 = Standard	

Area of table Covered by part	SQ FT 2
(No. Parts) .0077 = Standard	

Area of table Covered by part	SQ FT 2.5
(No. Parts) .0090 = Standard	

Area of table Covered by part	SQ FT 3
(No. Parts) .0101 = Standard	

Area of table Covered by part	SQ FT 3.5
(No. Parts) .0113 = Standard	

Area of table Covered by part	SQ FT 4
(No. Parts) .0125 = Standard	

Area of table Covered by part	SQ FT 4.5
(No. Parts) .0137 = Standard	

Area of table Covered by part	SQ FT 5
(No. Parts) .0150 = Standard	

Area of table Covered by part	SQ FT 5.5
(No. Parts) .0162 = Standard	

Area of table Covered by part	SQ FT 6
(No. Parts) .0174 = Standard	

Area of table Covered by part	SQ FT 7
(No. Parts) .0197 = Standard	

Area of table Covered by part	SQ FT 8
(No. Parts) .0221 = Standard	

Area of table Covered by part	SQ FT 9
(No. Parts) .0245 = Standard	

Area of table Covered by part	SQ FT 10
(No. Parts) .0269 = Standard	

Area of table Covered by part	SQ FT 11
(No. Parts) .0294 = Standard	

Area of table Covered by part	SQ FT 12
(No. Parts) .0318 = Standard	

Area of table Covered by part	SQ FT 13
(No. Parts) .0318 = Standard	

Area of table Covered by part	SQ FT 14
(No. Parts) .0341 = Standard	

Area of table Covered by part	SQ FT 15
(No. Parts) .0389 = Standard	

Area of table Covered by part	SQ FT 16
(No. Parts) .0414 = Standard	

TIME STANDARD FOR PAINTING

PAINTING LARGE SECTIONS

IRREGULAR SURFACES

AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS
10	0.0240	510	1.2240	1010	2.4240	1510	3.6240	2010	4.8240	2510	6.0240
20	0.0480	520	1.2480	1020	2.4480	1520	3.6480	2020	4.8480	2520	6.0480
30	0.0720	530	1.2720	1030	2.4720	1530	3.6720	2030	4.8720	2530	6.0720
40	0.0960	540	1.2960	1040	2.4960	1540	3.6960	2040	4.8960	2540	6.0960
50	0.1200	550	1.3200	1050	2.5200	1550	3.7200	2050	4.9200	2550	6.1200
60	0.1440	560	1.3440	1060	2.5440	1560	3.7440	2060	4.9440	2560	6.1440
70	0.1680	570	1.3680	1070	2.5680	1570	3.7680	2070	4.9680	2570	6.1680
80	0.1920	580	1.3920	1080	2.5920	1580	3.7920	2080	4.9920	2580	6.1920
90	0.2160	590	1.4160	1090	2.6160	1590	3.8160	2090	5.0160	2590	6.2160
100	0.2400	600	1.4400	1100	2.6400	1600	3.8400	2100	5.0400	2600	6.2400
110	0.2640	610	1.4640	1110	2.6640	1610	3.8640	2110	5.0640	2610	6.2640
120	0.2880	620	1.4880	1120	2.6880	1620	3.8880	2120	5.0880	2620	6.2880
130	0.3120	630	1.5120	1130	2.7120	1630	3.9120	2130	5.1120	2630	6.3120
140	0.3360	640	1.5360	1140	2.7360	1640	3.9360	2140	5.1360	2640	6.3360
150	0.3600	650	1.5600	1150	2.7600	1650	3.9600	2150	5.1600	2650	6.3600
160	0.3840	660	1.5840	1160	2.7840	1660	3.9840	2160	5.1840	2660	6.3840
170	0.4080	670	1.6080	1170	2.8080	1670	4.0080	2170	5.2080	2670	6.4080
180	0.4320	680	1.6320	1180	2.8320	1680	4.0320	2180	5.2320	2680	6.4320
190	0.4560	690	1.6560	1190	2.8560	1690	4.0560	2190	5.2560	2690	6.4560
200	0.4800	700	1.6800	1200	2.8800	1700	4.0800	2200	5.2800	2700	6.4800
210	0.5040	710	1.7040	1210	2.9040	1710	4.1040	2210	5.3040	2710	6.5040
220	0.5280	720	1.7280	1220	2.9280	1720	4.1280	2220	5.3280	2720	6.5280
230	0.5520	730	1.7520	1230	2.9520	1730	4.1520	2230	5.3520	2730	6.5520
240	0.5760	740	1.7760	1240	2.9760	1740	4.1760	2240	5.3760	2740	6.5760
250	0.6000	750	1.8000	1250	3.0000	1750	4.2000	2250	5.4000	2750	6.6000
260	0.6240	760	1.8240	1260	3.0240	1760	4.2240	2260	5.4240	2760	6.6240
270	0.6480	770	1.8480	1270	3.0480	1770	4.2480	2270	5.4480	2770	6.6480
280	0.6720	780	1.8720	1280	3.0720	1780	4.2720	2280	5.4720	2780	6.6720
290	0.6960	790	1.8960	1290	3.0960	1790	4.2960	2290	5.4960	2790	6.6960
300	0.7200	800	1.9200	1300	3.1200	1800	4.3200	2300	5.5200	2800	6.7200
310	0.7440	810	1.9440	1310	3.1440	1810	4.3440	2310	5.5440	2810	6.7440
320	0.7680	820	1.9680	1320	3.1680	1820	4.3680	2320	5.5680	2820	6.7680
330	0.7920	830	1.9920	1330	3.1920	1830	4.3920	2330	5.5920	2830	6.7920
340	0.8160	840	2.0160	1340	3.2160	1840	4.4160	2340	5.6160	2840	6.8160
350	0.8400	850	2.0400	1350	3.2400	1850	4.4400	2350	5.6400	2850	6.8400
360	0.8640	860	2.0640	1360	3.2640	1860	4.4640	2360	5.6640	2860	6.8640
370	0.8880	870	2.0880	1370	3.2880	1870	4.4880	2370	5.6880	2870	6.8880
380	0.9120	880	2.1120	1380	3.3120	1880	4.5120	2380	5.7120	2880	6.9120
390	0.9360	890	2.1360	1390	3.3360	1890	4.5360	2390	5.7360	2890	6.9360
400	0.9600	900	2.1600	1400	3.3600	1900	4.5600	2400	5.7600	2900	6.9600
410	0.9840	910	2.1840	1410	3.3840	1910	4.5840	2410	5.7840	2910	6.9840
420	1.0080	920	2.2080	1420	3.4080	1920	4.6080	2420	5.8080	2920	7.0080
430	1.0320	930	2.2320	1430	3.4320	1930	4.6320	2430	5.8320	2930	7.0320
440	1.0560	940	2.2560	1440	3.4560	1940	4.6560	2440	5.8560	2940	7.0560
450	1.0800	950	2.2800	1450	3.4800	1950	4.6800	2450	5.8800	2950	7.0800
460	1.1040	960	2.3040	1460	3.5040	1960	4.7040	2460	5.9040	2960	7.1040
470	1.1280	970	2.3280	1470	3.5280	1970	4.7280	2470	5.9280	2970	7.1280
480	1.1520	980	2.3520	1480	3.5520	1980	4.7520	2480	5.9520	2980	7.1520
490	1.1760	990	2.3760	1490	3.5760	1990	4.7760	2490	5.9760	2990	7.1760
500	1.2000	1000	2.4000	1500	3.6000	2000	4.8000	2500	6.0000	3000	7.2000

TIME STANDARDS FOR PAINTING

PAINTING LARGE SECTIONS

FLAT SURFACES

AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS	AREA SQ.FT.	STANDARD TIME HRS
10	0.0066	510	0.3366	1010	0.6666	1510	0.9966	2010	1.3266	2510	1.6566
20	0.0132	520	0.3432	1020	0.6732	1520	1.0032	2020	1.3332	2520	1.6632
30	0.0198	530	0.3498	1030	0.6798	1530	1.0098	2030	1.3398	2530	1.6698
40	0.0264	540	0.3564	1040	0.6864	1540	1.0164	2040	1.3464	2540	1.6764
50	0.0330	550	0.3630	1050	0.6930	1550	1.0230	2050	1.3530	2550	1.6830
60	0.0396	560	0.3696	1060	0.6996	1560	1.0296	2060	1.3596	2560	1.6896
70	0.0462	570	0.3762	1070	0.7062	1570	1.0362	2070	1.3662	2570	1.6962
80	0.0528	580	0.3828	1080	0.7128	1580	1.0428	2080	1.3728	2580	1.7028
90	0.0594	590	0.3894	1090	0.7194	1590	1.0494	2090	1.3794	2590	1.7094
100	0.0660	600	0.3960	1100	0.7260	1600	1.0560	2100	1.3860	2600	1.7160
110	0.0726	610	0.4026	1110	0.7326	1610	1.0626	2110	1.3926	2610	1.7226
120	0.0792	620	0.4092	1120	0.7392	1620	1.0692	2120	1.3992	2620	1.7292
130	0.0858	630	0.4158	1130	0.7458	1630	1.0758	2130	1.4058	2630	1.7358
140	0.0924	640	0.4224	1140	0.7524	1640	1.0824	2140	1.4124	2640	1.7424
150	0.0990	650	0.4290	1150	0.7590	1650	1.0890	2150	1.4190	2650	1.7490
160	0.1056	660	0.4356	1160	0.7656	1660	1.0956	2160	1.4256	2660	1.7556
170	0.1122	670	0.4422	1170	0.7722	1670	1.1022	2170	1.4322	2670	1.7622
180	0.1188	680	0.4488	1180	0.7788	1680	1.1088	2180	1.4388	2680	1.7688
190	0.1254	690	0.4554	1190	0.7854	1690	1.1154	2190	1.4454	2690	1.7754
200	0.1320	700	0.4620	1200	0.7920	1700	1.1220	2200	1.4520	2700	1.7820
210	0.1386	710	0.4686	1210	0.7986	1710	1.1286	2210	1.4586	2710	1.7886
220	0.1452	720	0.4752	1220	0.8052	1720	1.1352	2220	1.4652	2720	1.7952
230	0.1518	730	0.4818	1230	0.8118	1730	1.1418	2230	1.4718	2730	1.8018
240	0.1584	740	0.4884	1240	0.8184	1740	1.1484	2240	1.4784	2740	1.8084
250	0.1650	750	0.4950	1250	0.8250	1750	1.1550	2250	1.4850	2750	1.8150
260	0.1716	760	0.5016	1260	0.8316	1760	1.1616	2260	1.4916	2760	1.8216
270	0.1782	770	0.5082	1270	0.8382	1770	1.1682	2270	1.4982	2770	1.8282
280	0.1848	780	0.5148	1280	0.8448	1780	1.1748	2280	1.5048	2780	1.8348
290	0.1914	790	0.5214	1290	0.8514	1790	1.1814	2290	1.5114	2790	1.8414
300	0.1980	800	0.5280	1300	0.8580	1800	1.1880	2300	1.5180	2800	1.8480
310	0.2046	810	0.5346	1310	0.8646	1810	1.1946	2310	1.5246	2810	1.8546
320	0.2112	820	0.5412	1320	0.8712	1820	1.2012	2320	1.5312	2820	1.8612
330	0.2178	830	0.5478	1330	0.8778	1830	1.2078	2330	1.5378	2830	1.8678
340	0.2244	840	0.5544	1340	0.8844	1840	1.2144	2340	1.5444	2840	1.8744
350	0.2310	850	0.5610	1350	0.8910	1850	1.2210	2350	1.5510	2850	1.8810
360	0.2376	860	0.5676	1360	0.8976	1860	1.2276	2360	1.5576	2860	1.8876
370	0.2442	870	0.5742	1370	0.9042	1870	1.2342	2370	1.5642	2870	1.8942
380	0.2508	880	0.5808	1380	0.9108	1880	1.2408	2380	1.5708	2880	1.9008
390	0.2574	890	0.5874	1390	0.9174	1890	1.2474	2390	1.5774	2890	1.9074
400	0.2640	900	0.5940	1400	0.9240	1900	1.2540	2400	1.5840	2900	1.9140
410	0.2706	910	0.6006	1410	0.9306	1910	1.2606	2410	1.5906	2910	1.9206
420	0.2772	920	0.6072	1420	0.9372	1920	1.2672	2420	1.5972	2920	1.9272
430	0.2838	930	0.6138	1430	0.9438	1930	1.2738	2430	1.6038	2930	1.9338
440	0.2904	940	0.6204	1440	0.9504	1940	1.2804	2440	1.6104	2940	1.9404
450	0.2970	950	0.6270	1450	0.9570	1950	1.2870	2450	1.6170	2950	1.9470
460	0.3036	960	0.6336	1460	0.9636	1960	1.2936	2460	1.6236	2960	1.9536
470	0.3102	970	0.6402	1470	0.9702	1970	1.3002	2470	1.6302	2970	1.9602
480	0.3168	980	0.6468	1480	0.9768	1980	1.3068	2480	1.6368	2980	1.9668
490	0.3234	990	0.6534	1490	0.9834	1990	1.3134	2490	1.6434	2990	1.9734
500	0.3300	1000	0.6600	1500	0.9900	2000	1.3200	2500	1.6500	3000	1.9800

BLASTING AND PAINTING NON-PROCESS TIME

BLASTING

***NON-PROCESS* TIME**	Instructing or receiving instructions	4.1%
	Equipment problems	2.6%
	Fix equipment	l.9%
	Return tools	.6%
	Moving	.8%
	Other	.8%
		10. 8%

PAINTING

NON-PROCESS TIME	Instructing or receiving instructions	4.0%
	Help other departments	. 8%
	Fix equipment	.8%
	Moving	. 8%
	Return tools	.4%
	Wait for materials to dry	.4%
	Other	1.2%
		8.4%

SHIP PR
FACILI
OUTFITTIN
INDUSTRIAL ENGINEE
SHIPBUILD
DESIGN/PRODU
COMPUTER AID
SURFACE PREPARA
ENVIRONM
TECHN